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The invention relates to a mass flow measuring instrument for flowing mediums, which works after the Coriolis principle, with at least the flowing medium a leading Coriolis conduit, with at least the Coriolis conduit exciting vibrator, with at least two Coriolis oscillations seizing measuring sensors based on Coriolis forces and control unit evaluating with the vibrator heading for and the measurement signals of the measuring sensors, whereby the vibrator energizes the Coriolis conduit with a suggestion achievement and whereby in the control unit the suggestion achievement is to the vibrator supplying suggestion achievement generator provided.

Mass flow measuring instruments for flowing mediums, which work after the Coriolis principle, are in various embodiments known (see, the German Patent Laid opens 26 29 833, 28 22 087, 28 33 037, 29 38 496, 30 07 361, 33 29 544, 34 43 234, 35 03 841, 35 05 166, 35 26 297, 37 07 777, 39 16 285, 40 16 207, 41 24 295, 41 43 361, 42 00 060, 43 27 052, 44 13 239, 44 17 332 and 44 17 516, the European Patent Laid opens 0.083.144, 0.109.218, 0.119.638, 0.196.150, 0.210.308, 0.212.782, 0.232.679, 0.235.274, 0.243 468, 0.244.692, 0.271.605, 0.275.367 and 0.282.552, the French Patent Laid open 2.598.801 as well as the USA patent specifications 4.491.009, 4.628.744, 4.666.41, 4.803.867 and 4.962.678) and finds increasingly use.

A magnitude equally significant for all known mass flow measuring instruments is the amplitude of the suggestion oscillation of the Coriolis conduit. This amplitude is received contrary to the frequency of the suggestion oscillation of the Coriolis conduit not in first order into the measurement result for the mass flow by the mass flow measuring instrument, but only in higher order, caused by nonlinear effects with the deformation of the Coriolis conduit during the suggestion oscillation, yet straight these effects of higher order are smaller with the today required precision of a relative measuring accuracy than 0.1% at a mass flow value from 10% to 100% of nominal flow rate with mass flow measuring instruments, which work after the Coriolis principle, of particular importance.

The amplitude of the suggestion oscillation of the Coriolis conduit is dependent of a variety of factors. There is this to the characteristics of the oscillationable system in form of the Coriolis conduit, its immediate vicinity and the content of the Coriolis conduit, thus the flowing medium, actual, to second those the Coriolis conduit of the vibrator supplied suggestion achievement and finally the coupling of the oscillationable system to the external environment, thus to the surrounding piping system. The first two relative simple are to be controlled by these factors of influence, since they are predetermined or known. The coupling of the oscillationable system "mass flow measuring instrument" to the surrounding piping system is to the one in ahead the not known, more predeterminable on the other hand almost not. For this coupling relevant factors are for example the diameter and the wall thickness of the adjoining pipelines and also the distance between the connection of the mass flow measuring instrument to the adjoining pipeline of the next points of support of the adjoining pipelines. Depending upon coupling more or less a large part of the suggestion achievement for the suggestion oscillation lost, acting on the Coriolis conduits, goes to the Coriolis conduit of the mass flow measuring instrument to the angerenzenden pipelines and disappears in the adjoining piping system.

In order to ensure a sufficient accuracy of the mass flow measuring instrument, it is necessary that the amplitude of the suggestion oscillation of the Coriolis conduit does not fall below a minimum amplitude, since otherwise the measuring sensors do not supply evaluable signals more. So that this minimum amplitude of the suggestion oscillation of the Coriolis conduit is in the predominant number of the mounting types of the mass flow measuring instrument in a piping system ensured, a relative large suggestion achievement becomes predetermined with known mass flow measuring instruments during the manufacturing process, so that on the one hand the amplitude of the suggestion oscillation of the Coriolis conduit lies with optimum installation conditions significant over the minimum amplitude that on the other hand in addition, is ensured with a not optimum installation position of the mass flow measuring instrument a sufficient amplitude of the suggestion oscillation of the Coriolis conduit. Arises problem that one is all the more sources of error of higher order in-acted, the per large amplitude of the suggestion oscillation of the Coriolis conduit.

The invention is thus the basis the object to out-arrange and train the known mass flow measuring instruments further in such a way that the amplitude of the suggestion oscillation of the Coriolis conduit measured at the environment factors accepts, always one if possible optimum value.

The mass flow measuring instrument according to invention, with which the before derived and stated are solve the problem, is characterised in that the suggestion achievement of the suggestion achievement generator during the operation is more adjustable. According to invention is by the measure ensured that independent of the production process of the mass flow measuring instrument is during the operation of the mass flow measuring instrument an optimum value for the amplitude of the suggestion oscillation of the Coriolis conduit manual or automatic as more adjustable as possible. For example thus ensured can become with an optimum installation position of the mass flow measuring instrument within a piping system that the amplitude of the suggestion oscillation of the Coriolis conduit actual corresponds only to the minimum amplitude necessary to the optimum operation of the measuring sensors. Thereby is ensured that with

measurement error of higher order arising to high amplitude of the suggestion oscillation of the Coriolis conduit minimized are and thus the accuracy is significant increased with the determination of the mass flow.

In detail there is now a variety of possibilities to out-arrange and train the mass flow measuring instrument further according to invention. In addition referred on the one hand to those the claim 1 of downstream claims, on the other hand on the description of an embodiment in connection with the drawing. In the drawing the single fig shows the schematic structure of a preferred embodiment of a mass flow measuring instrument according to invention.

- ▲ <sup>top</sup> In the single fig of the drawing a preferred embodiment of a mass flow measuring instrument for flowing mediums, which works after the Coriolis principle, is schematically shown. This mass flow measuring instrument points to the flowing medium a leading Coriolis conduit 1, the Coriolis conduit to 1 exciting vibrator 2, two Coriolis oscillations seizing measuring sensors 3, 4 and the vibrator 2 heading for and the measurement signals of the measuring sensors 3, 4 evaluating control unit 5 based on Coriolis forces. Here that it is more conceivable, without one the measuring sensor 3, 4 is to be marked to do and instead of the signals of this measuring sensor 3 to convey to 4 the signals of the vibrator 2 of the control unit 5 to the evaluation. With the mass flow measuring instrument according to invention the vibrator 2 energizes the Coriolis conduit 1 with a suggestion achievement, whereby in the control unit 5 the suggestion achievement is to the vibrator 2 supplying suggestion achievement generator 6 provided. As is the case for the known mass flow measuring instruments the measurement signals of the measuring sensors 3, 4 a phase difference detector become 7 5 supplied in the control unit, that those the mass flow by the Coriolis conduit 1 proportional phase difference between the measurement signals of the measuring sensors 3, 4 certain.

The mass flow measuring instrument characterised in that the suggestion achievement of the suggestion achievement generator 6 is according to invention during the operation is more adjustable.

In accordance with first, not racks alternative the mass flow measuring instrument according to invention is designed by the fact that the suggestion achievement of the suggestion achievement generator is more adjustable 6 over an external accessible operating element. Thereby ensured becomes that an operator can increase the suggestion achievement on the basis the external accessible actuator so long, until the mass flow measuring instrument supplies reproducible values and/or, while a calibration process supplies the corresponding measurement value for a predetermined mass flow. Thus is ensured that the suggestion oscillation of the Coriolis conduit 1 does not exhibit unnecessary high amplitude.

A particularly preferred embodiment experiences the preferred embodiment of a mass flow measuring instrument according to invention represented in the fig by the fact that 8 provided in the control unit 5 the amplitude of the suggestion oscillation is as controlled variable on a set value of held controllers and the controller 8 affects the suggestion achievement of the suggestion achievement generator 6 as manipulated variable of the control circuit. Thereby independent of all possible factors becomes a constant amplitude of the suggestion oscillation of the Coriolis conduit 1 ensured. If the set value for the amplitude corresponds to the suggestion oscillation of the Coriolis conduit 1 of the optimum minimum amplitude which can be evaluated by the measuring sensors 3, 4, then a constant high measuring accuracy for the mass flow is ensured by this measure.

An other embodiment experiences the represented embodiment of a mass flow measuring instrument according to invention by the fact that the controller 8 the average of the amplitudes of the measurement signals becomes as actual value supplied. Thus that the controller 8 the average of the amplitudes of the measurement signals becomes as actual value supplied, the accuracy of the measurement becomes increased.

Alternative one to the before described embodiment of the preferred embodiment a made development by the fact that the controller 8 the sum of the amplitudes of the measurement signals becomes as actual value supplied. Here a simplification becomes that achieved compared with the before shown embodiment, since the amplitudes of the measurement signals not independently certain and subsequent averaged must to become have, but the amplitude of the summed measurement signals only once certain become.

The amplitude at least a measurement signal knows alternative immediate from the measurement signal, D. h. by comparisons of the measurement signals various times, or from a temporal average of the measurement signal certain become indirect, since the measurement signal essentially corresponds to a sine function. The last alternative to the determination of the amplitude of the measurement signal can become for example by the fact realized that becomes integrated in a predetermined time interval the absolute value of each measurement signal. The determination of the amplitude at least a measurement signal made with the preferred embodiment in an amplitude detector 9 planned in the control unit 5.

Since in the preferred embodiment the suggestion achievement generator 6 does not have to supply the suggestion achievement to continuous to the vibrator 2 with, the mass flow measuring instrument according to invention is preferred designed by the fact that the controller 8 the temporal average of the suggestion achievement affected supplied by the suggestion achievement generator 6.

A particularly preferred embodiment experiences the preferred embodiment of a mass flow measuring instrument according to invention represented in the fig by the fact that the suggestion achievement generator supplies 6 pulse-wide-controlled achievement pulses to the vibrator 2. Thereby a particularly simple interference of the suggestion achievement is ensured.

An other particularly advantageous embodiment experiences the preferred embodiment of a erfindungsgegemässen mass flow measuring instrument by the fact that the suggestion achievement is a display element 10 provided indicative as measure for the installation-good of the mass flow measuring instrument. Both in case of the manual adjustment of the suggestion achievement of the suggestion achievement generator 6 by an operator and in case of a control of the amplitude of the suggestion oscillation the suggestion achievement necessary for the desired highly precise operation of the mass flow measuring instrument is a measure for the installation-good is for example the suggestion achievement relative low, then the coupling of the mass flow measuring instrument is likewise low to the surrounding piping system. Is from particular advantage the indication of the suggestion achievement necessary for a highly precise operation, because the coupling of the mass flow measuring instrument to the surrounding piping system with the known mass flow measuring instruments not only the amplitude of the suggestion oscillation of the Coriolis conduit 1 affected, but because an increased coupling is likewise responsible for increased interspersing of oscillations present in the adjoining piping

system into the mass flow measuring instrument, whereby these stray effects can impair the measurements of the phase difference between the measurement signals of the measuring sensors 3, 4 significant. Thus if the display element indicates an high suggestion achievement to 10, then this for the operator a reference is on it that the incorporation is to be optimized, around a measuring accuracy matching with the specifications of the mass flow measuring instrument to be obtained. In the preferred embodiment represented in the fig the display element serves 10 beside the indication of the suggestion achievement likewise for the indication of the mass flow, which results from the phase difference certain in the phase difference detector 7. Of course a separate display element can be provided to the indication of the suggestion achievement.

Finally the preferred embodiment of a mass flow measuring instrument according to invention represented in the fig can be improved by the fact that in the control unit 5 with exceeding of a predetermined maximum suggestion achievement a warning signal is over a warning element 11 spending threshold value comparator 12 provided. Over this threshold value comparator 12 and the warning element 11 the operator signaled becomes that the suggestion achievement is in a range, which points on the fact that the incorporation of the mass flow measuring instrument is to be optimized. The warning element 11 can be naturally alternative in the display element 10 integrated.